



U.S. Department
of Transportation
**Federal Aviation
Administration**

800 Independence Ave., S.W.
Washington, D.C. 20591

June 15, 2015

Exemption No. 11806
Regulatory Docket No. FAA-2015-0386

Mr. Karl Engstrom
President and CEO
Terra Imaging LLC
P.O. Box 4213
Telluride, CO 81435

Dear Mr. Engstrom:

This letter is to inform you that we have granted your request for exemption. It transmits our decision, explains its basis, and gives you the conditions and limitations of the exemption, including the date it ends.

The Basis for Our Decision

By letter dated February 1, 2015, you petitioned the Federal Aviation Administration (FAA) on behalf of Terra Imaging LLC (hereinafter petitioner or operator) for an exemption. The exemption would allow the petitioner to operate an unmanned aircraft system (UAS) to conduct aerial surveys, photography and closed set cinematography.

See Appendix A for the petition submitted to the FAA describing the proposed operations and the regulations that the petitioner seeks an exemption.

The FAA has determined that good cause exists for not publishing a summary of the petition in the Federal Register because the requested exemption would not set a precedent, and any delay in acting on this petition would be detrimental to the petitioner.

Airworthiness Certification

The UAS proposed by the petitioner are the Trimble UX5 and DJI S1000.

The petitioner requested relief from 14 CFR part 21, *Certification procedures for products and parts, Subpart H—Airworthiness Certificates*. In accordance with the statutory criteria provided in Section 333 of Public Law 112–95 in reference to 49 U.S.C. § 44704, and in consideration of the size, weight, speed, and limited operating area associated with the aircraft and its operation, the Secretary of Transportation has determined that this aircraft meets the conditions of Section 333. Therefore, the FAA finds that the requested relief from 14 CFR part 21, *Certification procedures for products and parts, Subpart H—Airworthiness Certificates*, and any associated noise certification and testing requirements of part 36, is not necessary.

The Basis for Our Decision

You have requested to use a UAS for aerial data collection and closed set motion picture and filming. The FAA has issued grants of exemption in circumstances similar in all material respects to those presented in your petition. In Grants of Exemption Nos. 11062 to Astraeus Aerial (*see* Docket No. FAA–2014–0352), 11109 to Clayco, Inc. (*see* Docket No. FAA–2014–0507), 11112 to VDOS Global, LLC (*see* Docket No. FAA–2014–0382), and 11213 to Aeryon Labs, Inc. (*see* Docket No. FAA–2014–0642), the FAA found that the enhanced safety achieved using an unmanned aircraft (UA) with the specifications described by the petitioner and carrying no passengers or crew, rather than a manned aircraft of significantly greater proportions, carrying crew in addition to flammable fuel, gives the FAA good cause to find that the UAS operation enabled by this exemption is in the public interest.

Having reviewed your reasons for requesting an exemption, I find that—

- They are similar in all material respects to relief previously requested in Grant of Exemption Nos. 11062, 11109, 11112, and 11213;
- The reasons stated by the FAA for granting Exemption Nos. 11062, 11109, 11112, and 11213 also apply to the situation you present; and
- A grant of exemption is in the public interest.

Our Decision

In consideration of the foregoing, I find that a grant of exemption is in the public interest. Therefore, pursuant to the authority contained in 49 U.S.C. 106(f), 40113, and 44701, delegated to me by the Administrator, Terra Imaging LLC is granted an exemption from 14 CFR §§ 61.23(a) and (c), 61.101(e)(4) and (5), 61.113(a), 61.315(a), 91.7(a), 91.119(c), 91.121, 91.151(a)(1), 91.405(a), 91.407(a)(1), 91.409(a)(1) and (2), and 91.417(a) and (b), to the extent necessary to allow the petitioner to operate a UAS to perform aerial data collection and closed set motion picture and filming. This exemption is subject to the conditions and limitations listed below.

Conditions and Limitations

In this grant of exemption, Terra Imaging LLC is hereafter referred to as the operator.

Failure to comply with any of the conditions and limitations of this grant of exemption will be grounds for the immediate suspension or rescission of this exemption.

1. Operations authorized by this grant of exemption are limited to the Trimble UX5 and DJI S1000 when weighing less than 55 pounds including payload. Proposed operations of any other aircraft will require a new petition or a petition to amend this exemption.
2. Operations for the purpose of closed-set motion picture and television filming are permitted.
3. The UA may not be operated at a speed exceeding 87 knots (100 miles per hour). The exemption holder may use either groundspeed or calibrated airspeed to determine compliance with the 87 knot speed restriction. In no case will the UA be operated at airspeeds greater than the maximum UA operating airspeed recommended by the aircraft manufacturer.
4. The UA must be operated at an altitude of no more than 400 feet above ground level (AGL). Altitude must be reported in feet AGL.
5. The UA must be operated within visual line of sight (VLOS) of the PIC at all times. This requires the PIC to be able to use human vision unaided by any device other than corrective lenses, as specified on the PIC's FAA-issued airman medical certificate or U.S. driver's license.
6. All operations must utilize a visual observer (VO). The UA must be operated within the visual line of sight (VLOS) of the PIC and VO at all times. The VO may be used to satisfy the VLOS requirement as long as the PIC always maintains VLOS capability. The VO and PIC must be able to communicate verbally at all times; electronic messaging or texting is not permitted during flight operations. The PIC must be designated before the flight and cannot transfer his or her designation for the duration of the flight. The PIC must ensure that the VO can perform the duties required of the VO.
7. This exemption and all documents needed to operate the UAS and conduct its operations in accordance with the conditions and limitations stated in this grant of exemption, are hereinafter referred to as the operating documents. The operating documents must be accessible during UAS operations and made available to the Administrator upon request. If a discrepancy exists between the conditions and limitations in this exemption and the procedures outlined in the operating documents,

the conditions and limitations herein take precedence and must be followed. Otherwise, the operator must follow the procedures as outlined in its operating documents. The operator may update or revise its operating documents. It is the operator's responsibility to track such revisions and present updated and revised documents to the Administrator or any law enforcement official upon request. The operator must also present updated and revised documents if it petitions for extension or amendment to this grant of exemption. If the operator determines that any update or revision would affect the basis upon which the FAA granted this exemption, then the operator must petition for an amendment to its grant of exemption. The FAA's UAS Integration Office (AFS-80) may be contacted if questions arise regarding updates or revisions to the operating documents.

8. Any UAS that has undergone maintenance or alterations that affect the UAS operation or flight characteristics, e.g., replacement of a flight critical component, must undergo a functional test flight prior to conducting further operations under this exemption. Functional test flights may only be conducted by a PIC with a VO and must remain at least 500 feet from other people. The functional test flight must be conducted in such a manner so as to not pose an undue hazard to persons and property.
9. The operator is responsible for maintaining and inspecting the UAS to ensure that it is in a condition for safe operation.
10. Prior to each flight, the PIC must conduct a pre-flight inspection and determine the UAS is in a condition for safe flight. The pre-flight inspection must account for all potential discrepancies, e.g., inoperable components, items, or equipment. If the inspection reveals a condition that affects the safe operation of the UAS, the aircraft is prohibited from operating until the necessary maintenance has been performed and the UAS is found to be in a condition for safe flight.
11. The operator must follow the UAS manufacturer's maintenance, overhaul, replacement, inspection, and life limit requirements for the aircraft and aircraft components.
12. Each UAS operated under this exemption must comply with all manufacturer safety bulletins.
13. Under this grant of exemption, a PIC must hold either an airline transport, commercial, private, recreational, or sport pilot certificate. The PIC must also hold a current FAA airman medical certificate or a valid U.S. driver's license issued by a state, the District of Columbia, Puerto Rico, a territory, a possession, or the Federal government. The PIC must also meet the flight review requirements specified in 14 CFR § 61.56 in an aircraft in which the PIC is rated on his or her pilot certificate.

14. The operator may not permit any PIC to operate unless the PIC demonstrates the ability to safely operate the UAS in a manner consistent with how the UAS will be operated under this exemption, including evasive and emergency maneuvers and maintaining appropriate distances from persons, vessels, vehicles and structures. PIC qualification flight hours and currency must be logged in a manner consistent with 14 CFR § 61.51(b). Flights for the purposes of training the operator's PICs and VOs (training, proficiency, and experience-building) and determining the PIC's ability to safely operate the UAS in a manner consistent with how the UAS will be operated under this exemption are permitted under the terms of this exemption. However, training operations may only be conducted during dedicated training sessions. During training, proficiency, and experience-building flights, all persons not essential for flight operations are considered nonparticipants, and the PIC must operate the UA with appropriate distance from nonparticipants in accordance with 14 CFR § 91.119.
15. UAS operations may not be conducted during night, as defined in 14 CFR § 1.1. All operations must be conducted under visual meteorological conditions (VMC). Flights under special visual flight rules (SVFR) are not authorized.
16. The UA may not operate within 5 nautical miles of an airport reference point (ARP) as denoted in the current FAA Airport/Facility Directory (AFD) or for airports not denoted with an ARP, the center of the airport symbol as denoted on the current FAA-published aeronautical chart, unless a letter of agreement with that airport's management is obtained or otherwise permitted by a COA issued to the exemption holder. The letter of agreement with the airport management must be made available to the Administrator or any law enforcement official upon request.
17. The UA may not be operated less than 500 feet below or less than 2,000 feet horizontally from a cloud or when visibility is less than 3 statute miles from the PIC.
18. If the UAS loses communications or loses its GPS signal, the UA must return to a pre-determined location within the private or controlled-access property.
19. The PIC must abort the flight in the event of unpredicted obstacles or emergencies.
20. The PIC is prohibited from beginning a flight unless (considering wind and forecast weather conditions) there is enough available power for the UA to conduct the intended operation and to operate after that for at least five minutes or with the reserve power recommended by the manufacturer if greater.
21. Air Traffic Organization (ATO) Certificate of Waiver or Authorization (COA). All operations shall be conducted in accordance with an ATO-issued COA. The exemption holder may apply for a new or amended COA if it intends to conduct operations that cannot be conducted under the terms of the attached COA.

22. All aircraft operated in accordance with this exemption must be identified by serial number, registered in accordance with 14 CFR part 47, and have identification (N-Number) markings in accordance with 14 CFR part 45, Subpart C. Markings must be as large as practicable.
23. Documents used by the operator to ensure the safe operation and flight of the UAS and any documents required under 14 CFR §§ 91.9 and 91.203 must be available to the PIC at the Ground Control Station of the UAS any time the aircraft is operating. These documents must be made available to the Administrator or any law enforcement official upon request.
24. The UA must remain clear and give way to all manned aviation operations and activities at all times.
25. The UAS may not be operated by the PIC from any moving device or vehicle.
26. All Flight operations must be conducted at least 500 feet from all nonparticipating persons, vessels, vehicles, and structures unless:
 - a. Barriers or structures are present that sufficiently protect nonparticipating persons from the UA and/or debris in the event of an accident. The operator must ensure that nonparticipating persons remain under such protection. If a situation arises where nonparticipating persons leave such protection and are within 500 feet of the UA, flight operations must cease immediately in a manner ensuring the safety of nonparticipating persons; and
 - b. The owner/controller of any vessels, vehicles or structures has granted permission for operating closer to those objects and the PIC has made a safety assessment of the risk of operating closer to those objects and determined that it does not present an undue hazard.

The PIC, VO, operator trainees or essential persons are not considered nonparticipating persons under this exemption.

27. All operations shall be conducted over private or controlled-access property with permission from the property owner/controller or authorized representative. Permission from property owner/controller or authorized representative will be obtained for each flight to be conducted.
28. Any incident, accident, or flight operation that transgresses the lateral or vertical boundaries of the operational area as defined by the applicable COA must be reported to the FAA's UAS Integration Office (AFS-80) within 24 hours. Accidents must be reported to the National Transportation Safety Board (NTSB) per instructions contained on the NTSB Web site: www.nts.gov.

If this exemption permits operations for the purpose of closed-set motion picture and television filming and production, the following additional conditions and limitations apply.

29. The operator must have a motion picture and television operations manual (MPTOM) as documented in this grant of exemption.
30. At least 3 days before aerial filming, the operator of the UAS affected by this exemption must submit a written Plan of Activities to the local Flight Standards District Office (FSDO) with jurisdiction over the area of proposed filming. The 3-day notification may be waived with the concurrence of the FSDO. The plan of activities must include at least the following:
 - a. Dates and times for all flights;
 - b. Name and phone number of the operator for the UAS aerial filming conducted under this grant of exemption;
 - c. Name and phone number of the person responsible for the on-scene operation of the UAS;
 - d. Make, model, and serial or N-Number of UAS to be used;
 - e. Name and certificate number of UAS PICs involved in the aerial filming;
 - f. A statement that the operator has obtained permission from property owners and/or local officials to conduct the filming production event; the list of those who gave permission must be made available to the inspector upon request;
 - g. Signature of exemption holder or representative; and
 - h. A description of the flight activity, including maps or diagrams of any area, city, town, county, and/or state over which filming will be conducted and the altitudes essential to accomplish the operation.
31. Flight operations may be conducted closer than 500 feet from participating persons consenting to be involved and necessary for the filming production, as specified in the exemption holder's MPTOM.

Unless otherwise specified in this grant of exemption, the UAS, the UAS PIC, and the UAS operations must comply with all applicable parts of 14 CFR including, but not limited to, parts 45, 47, 61, and 91.

This exemption terminates on June 30, 2017, unless sooner superseded or rescinded.

Sincerely,

/s/

John S. Duncan

Director, Flight Standards Service

February 1st 2015

U.S. Department of Transportation
Docket Management System
1200 New Jersey Ave., SE
Washington, DC 20590

Re: Exemption Request Under Section 333 of the FAA Reform Act and
Part 11 of the Federal Aviation Regulations

Dear Sir or Madam:

Pursuant to Section 333 of the FAA Modernization and Reform Act of 2012 (the “Reform Act”) and 14 C.F.R. Part 11, Terra Imaging LLC (“Terra Imaging”), operators of Unmanned Aircraft System (“UAS”), seeks an exemption from the Federal Aviation Regulations (“FARs”) listed below.

The requested exemption would permit commercial operation of Trimble’s UX5 and DJI S1000, which perform precision aerial surveys and closed set cinematography that consist of digital imagery taken by onboard cameras. Both UAS will be operated by Terra Imaging and will be registered in accordance with 49 U.S.C. 44103, *Registration of Aircraft*, as well as 14 C.F.R. Part 47, *Aircraft Registration*, and marked in accordance with 14 C.F.R. Part 45, *Identification and Registration Marking*.

Moreover, the Trimble UX5 and DJI S1000 camera systems collect imagery and mapping data that are used to produce precision 3D topographic maps and 3D models. Applications for general UAS operations include agriculture, mining, and professional surveying. Use of the UAS for aerial mapping reduces the need to operate conventional aircraft thereby saving thousands of dollars on operations and fuel costs, producing jobs locally and nationwide. Both the Trimble UX5 and DJI S1000 are battery powered emitting zero fossil fuels or emissions providing a greener airborne mapping solution. Terra Imaging is actively involved with various wildlife conservation and marine research agencies, the benefit of a UAS system to these entities would provide affordable data for scientific and education purposes, the benefits of current, high resolution mapping data to the public sector are enormous.

The requested exemption would authorize commercial operations of UAS under controlled conditions by UAS professionals, formally trained as Trimble Certified UAS Pilots and Operators; specifically operating all UAS operations within FAA pre approved airspace disclosed in advance with FAA Flight Planning.

Traditional precision aerial surveys, airborne photogrammetry and cinematography include use of the following airborne camera and sensor systems:

- Photogrammetry Cameras
- Cinematography Cameras
- LiDAR Sensors

The name and address of the applicant is:

Terra Imaging LLC
58 Canyon Court
Telluride, CO 81435

Mailing Address:

Terra Imaging LLC
PO Box 4213
Telluride, CO 81435

Regulations from which the exemption is requested:

14 CFR Part 21 subpart H
14 CFR 45.23 (b)
14 CFR 61.113 (a) & (b)
14 CFR 91.7 (a)
14 CFR 91.9 (b) (2)
14 CFR 91.103
14 CFR 91.109
14 CFR 91.119 (c)
14 CFR 91.121
14 CFR 91.151 (a)
14 CFR 91.203 (a) & (b)
14 CFR 91.405 (a)
14 CFR 91.407 (a) (1)
14 CFR 91.409 (a) (2)
14 CFR 91.417 (a) & (b)

Terra Imaging will operate the Trimble UX5 with the following hardware, software and in accordance with all FCC radio frequency specifications below:

[Hardware Type Fixed wing

Weight 2.5 kg (5.51 lb)

Wing span 1 m (3.28 ft)

Wing area 34 dm

Dimensions 100 cm x 65 cm x 10 cm (39.37 in x 25.59 in x 4.13 in)

Material EPP foam; Carbon frame structure; Composite elements Propulsion Electric pusher propeller; brushless 700 W motor Battery 14.8 V, 6000 mAh

Software Project management } Mission planning Multiple flights Automated pre-flight checks }
Automatic take off, flight, and landing } Autonomous camera triggering } Automated fail-safe
routines } User-controlled fail-safe commands } Automated post-flight checks } Operation
Endurance 1 50 minutes Range 1 60 km (37.28 mi) Cruise speed 80 kmh (49.71 mph) Maximum
ceiling 5,000 m (16,404 ft) Pre-flight system setup time 5 minutes Take off type Catapult launch
Take off angle 30 degrees Landing type Belly landing Landing angle 14 degrees Recommend
landing spacing (LxW) 2 50 m x 30 m (164 ft x 98.43 ft) Weather limit 65 kmh (40.39 mph) and
light rain Communication and control frequency 2.4 GHz Communication and control range Up
to 5 km (3.11 mi)

Height above take-off location (AGL) 75 m to 750 m (246 ft x 2,460 ft)]

Terra Imaging will operate the DJI S1000 with the following hardware, software and in accordance with all FCC radio frequency specifications below:

Frame	Diagonal Wheelbase 1045mm Frame Arm Length 386mm Frame Arm Weight (Including Motor, ESC, Propeller) 325g Center Frame Diameter 337.5mm Center Frame Weight (With Landing Gear Mounting Base, Servos) 1330g Landing Gear Size 460mm (Length) ×511mm (Width) ×305mm (Height), (Top width: 155 mm)
Motor	Stator Size 41×14mm KV 400rpm/V Max Power 500W Weight(With Cooling Fan) 158g
ESC	Working Current 40A Working Voltage 6S LiPo Signal Frequency 30Hz ~ 450Hz Drive PWM Frequency 8KHz Weight(With Radiators) 35g
Foldable Propeller (1552/1552R)	Material High strength performance engineered plastics Size 15×5.2inch Weight 13g
Flight Parameters	Takeoff Weight 6.0Kg ~ 11.0Kg Total Weight 4.2Kg Power Battery LiPo (6S、 10000mAh~20000mAh、 15C(Min))

	Max Power Consumption 4000W Hover Power Consumption 1500W (@9.5Kg Takeoff Weight) Hover Time 15min (@15000mAh & 9.5Kg Takeoff Weight) Working Environment Temperature -10 °C ~ +40 °C
Gain Value Settings	For A2 Flight Controller Basic: Roll 120%, Pitch 120%, Yaw 120% Attitude: Roll 170%, Pitch 170%, Vertical 120% For WooKong-M Flight Controller Basic: Roll 180%, Pitch 180%, Yaw 120% Attitude: Roll 180%, Pitch 180%, Vertical 120%

Terra Imaging acknowledges the operational use of the Trimble UX5 and DJI S1000 are within FAA adherence of proposed regulations based on:

- UAS's size, weight, speed, and operational capability
- Operation of the UAS NOT in close proximity to airports and populated areas;
- Operation of the UAS within visual line of sight of the operator.

Under grant of the exemption, Terra Imaging agrees to operate the Trimble UX5 and DJI S1000 with the following restrictions:

- All operations to occur in Class G airspace.
- All UAS will weigh less than 50lbs.
- All airborne operations occur during daylight hours.
- All UAS pilots, will be professionally trained and certified UAS pilots, formally trained as a Certified Trimble UAS Pilot and Operator.
- Operations to avoid congested or populated areas, which are depicted in yellow on VFR charts.
- Operations to be conducted over private or controlled-access property.
- Permission from land owner/controller required before commencing any flight.
- Operations to occur during Visual Flight Rules Meteorological Conditions (VMC).
- Aircraft to remain within Visual Line of Sight (VLOS). o
- VLOS guaranteed with a cylinder of operation around operator of .5 nautical miles (NM).
- Cylinder walls may be expanded by observer with ability to control aircraft.
- Above Ground Level (AGL) altitude to be restricted to 500 feet.
- All operations conducted in vicinity of airport to remain more than 2.5 NM from centerline azimuth of runway centerline measured from runway thresholds.

- Operator will file a NOTAM for each flight.
- All required permissions and permits will be obtained from territorial, state, county or city jurisdictions, including local law enforcement, fire, or other appropriate governmental agencies.

Terra Imaging based on the recommendations of Trimble and DJI, agrees to the Operator Requirements. In detail, the Trimble UX5 and DJI S1000 have a semi-autonomous navigation and control system comprised of a Ground Control Station (GCS) and auto-pilot system. All flights are pre-programmed with GPS guidance and do not require human intervention. Flight mission area and routing cannot be changed after launch. Flights are not directed by positive manual control, nor are evasive maneuvers. In the case of unplanned events, the operator inputs pre-programmed evasive maneuvers from the control unit and the control unit executes that maneuver. Pre-programmed operator interventions include diversion to the right; initiation of holding at present position; suspension of mission; fly back to launch point; fly to point and hold; abort mission and land; and emergency power cut off and land (Flight Termination System).

Additional automated safety functions and safety enhancing features of the UAS include the following:

- Auto-pilot detection of lost GPS or of insufficient satellites initiates an immediate spiral landing.
- Low power on the aircraft triggers escalating alarms at GCS at 35% and 10% levels.
- If the auto-pilot detects a lost-link to the GCS for longer than 30 seconds, landing procedure begins.
- The UAS is inherently unstable, so auto-pilot fail will result in very rapid exit from flight.
- Aircraft has an on-board failsafe.

In summary, Terra Imaging seeks an exemption from the FARs set forth bellow to allow commercial operations of a small unmanned vehicle conducting precision aerial surveys and closed set cinematography. Approval of the exemption allowing commercial operations of the Trimble UX5 and DJI S1000 for precision survey work will enhance safety by reducing risk. Both the Trimble UX5 and DJI S1000 are carried to the survey location, not flown there. The Trimble UX5 and DJI S1000 will carry no passengers or crew and, therefore, will not expose any individuals to the risks associated with manned aircraft flights. Additionally, no national security issue is raised by the grant of the requested exemptions. Given the size, load carrying capacity, speed at which it operates, and the fact that it carries no explosives or other dangerous materials, the Trimble UX5 and DJI S1000 poses no threat to national security.

Following are the Exemptions Requested:

14 C.F.R. Part 21, Subpart H: Airworthiness Certificates

14 CFR § 91.203(a)(1)

Section 91.203(a)(1) requires all civil aircraft to have a certificate of airworthiness. Part 21, Subpart H, entitled Airworthiness Certificates, establishes the procedural requirements for the issuance of airworthiness certificates as required by FAR § 91.203(a)(1). Given the size of the aircraft (5.5lbs.) and the limited operating area associated with its utilization, it is unnecessary to go through the certificate of airworthiness process under Part 21 Subpart H to achieve or exceed current safety levels. Such an exemption meets the requirements of an equivalent level of safety under Part 11 and Section 333 of the Reform Act. The Federal Aviation Act and Section 333 of the Reform Act both authorize the FAA to exempt aircraft from the requirement for an airworthiness certificate, upon consideration of the size, weight, speed, operational capability, and proximity to airports and populated areas of the UAS involved.

In this case, an analysis of these criteria demonstrates that the Trimble UX5 and DJI S1000 operated without an airworthiness certificate, under the conditions proposed herein, will be at least as safe, or safer, than a conventional aircraft (fixed wing or rotorcraft) with an airworthiness certificate. The Trimble UX5 and DJI S1000 weighs less than 25lbs. fully loaded. It will not carry a pilot or passenger, will not carry flammable fuel, and will operate exclusively within an area pre-disclosed and in compliance with conditions set forth herein. Operations under this exemption will be tightly controlled and monitored by both the operator, pursuant to the conditions set forth above, and by local public safety requirements. The FAA will have advance notice of all operations through the filing of NOTAMs. Receipt of the prior permission of the land owner, the size of the aircraft, the lack of flammable fuel, and the fact that the aircraft is carried to the location and not flown there all establish the equivalent level of safety. The Trimble UX5 and DJI S1000 construction with absorbent material provides at least an equivalent level of safety to that of such operations being conducted with conventional aircraft that would be orders-of-magnitude larger and would be carrying passengers, cargo, and flammable fuel.

14 C.F.R. § 45.23 (b). Marking of the Aircraft

The regulation requires:

When marks include only the Roman capital letter "N" and the registration number is displayed on limited, restricted or light-sport category aircraft or experimental or provisionally certificated aircraft, the operator must also display on that aircraft near each entrance to the cabin, cockpit, or pilot station, in letters not less than 2 inches nor more than 6 inches high, the words "limited," "restricted," "light-sport," "experimental," or "provisional," as applicable.

The Trimble UX5 and DJI S1000 have no entrance to the cabin, cockpit or pilot station on which the word “Experimental” can be placed. Given the size of the UAS, two-inch lettering will be impossible. The word “Experimental” will be placed on the fuselage in compliance with §45.29 (f). The equivalent level of safety, which is fully sufficient for

the small UAS size, will be provided by having the UAS marked on its fuselage as required by §45.29 (f) where the pilot, observer and others working with the UAS will see the identification of the UAS as “Experimental.”

14 C.F.R. § 61.113 (a) and (b): Private Pilot Privileges and Limitations: Pilot in Command. Pursuant to 14 CFR 61.113 (a) & (b), no person who holds a private pilot certificate may act as a pilot in command of an aircraft that is carrying passengers or property for compensation or hire.

Section 61.113(a) & (b) limit private pilots to non-commercial operations. Unlike a conventional aircraft that carries a pilot, passengers, and cargo, the Trimble UX5 and DJI S1000 in this case is remotely controlled with no passengers or property of others on board. Section 61.133(a) requires an individual with a commercial pilot’s license to be pilot in command of an aircraft for compensation or hire. The Trimble UX5 and DJI S1000 has a high degree of pre-programmed control and various built-in technical capabilities that strictly limit the potential for operation outside of the operating conditions set forth in the exemption application.

Both UAS have a semi-autonomous navigation and control system comprised of a Ground Control Station (GCS) and auto-pilot system. All flights are pre-programmed with precision GPS guidance and do not require human intervention. Flight mission area and routing cannot be changed after launch. Flights are not directed by positive manual control, nor are evasive maneuvers. In the case of unplanned events, the operator inputs pre-programmed evasive maneuvers from the control unit, and the control unit executes that maneuver. Pre-programmed operator interventions include diversion to the right; initiation of holding at present position; suspension of mission; fly back to launch point; fly to point and hold; abort mission and land; and emergency power cut off and land (Flight Termination System).

Additional automated safety functions and safety enhancing features of the Trimble UX5 and DJI S1000 include the following:

- Auto-pilot detection of lost GPS or of insufficient satellites initiates an immediate spiral landing.
- Low power on the aircraft triggers escalating alarms at GCS at 35% and 10% levels.
- If the auto-pilot detects a lost-link to the GCS for longer than 30 seconds, landing procedure begins.
- The Trimble UX5 and DJI S1000 are inherently unstable, so auto-pilot fail will result in very rapid exit from flight.
- Aircraft has an on-board failsafe that limits speed in the event of dive to approximately 14 m/s.

- The aircraft, weighing less than 6 lbs., fully loaded, is constructed of EPP foam, or similar material which is intended to absorb impact energy.
- The motor is driven by a pulse width modulated signal, not an analog signal.

Given these safety features, Terra Imaging proposes that operators of the Trimble UX5 and DJI S1000 should not be required to hold a commercial or private pilot certification. Instead, operators should be required to:

- Have successfully completed, at a minimum Certified Trimble UAS Pilot and Operations training.
- Have completed the manufacturer's training program for operation of the UAS. The manufacturer's training program will have been satisfactorily reviewed through the SAC process.

Given these conditions and restrictions, an equivalent level of safety will be provided by allowing operation of the Trimble UX5 and DJI S1000 without a private pilot's certificate or a commercial pilot's certificate, under the conditions set forth herein. The risks associated with the operation of the Trimble UX5 and DJI S1000 (given its size, speed, operational capabilities, and lack of combustible fuel) are so diminished from the level of risk associated with private pilot operations or commercial operations contemplated by Part 61 with conventional aircraft (fixed wing or rotorcraft), that allowing operations of the UAS as set forth above meets or exceeds the present level of safety provided under 14 C.F.R. § 61.113(a) & (b) and does not rise to the level of requiring a commercial pilot to operate the aircraft under § 61.133(a).

14 C.F.R. §91.7(a): Civil Aircraft Airworthiness.

The regulation requires that no person may operate a civil aircraft unless it is in airworthy condition. As there will be no airworthiness certificate issued for the Trimble UX5 and DJI S1000, should this exemption be granted, no FAA regulatory standard will exist for determining airworthiness. Given the size of the aircraft for maintenance and use of safety check lists prior to each flight an equivalent level of safety will be provided.

14 C.F.R. § 91.9 (b) (2): Civil Aircraft Flight Manual in the Aircraft.

Section 91.9 (b) (2) provides: No person may operate a U.S.-registered civil aircraft ... (2) For which an Airplane or Rotorcraft Flight Manual is not required by §21.5 of this chapter, unless there is available in the aircraft a current approved airplane or Rotorcraft Flight Manual, approved manual material, markings, and placards, or any combination thereof.

The UAS, given its size and configuration has no ability or place to carry such a flight manual on the aircraft, not only because there is no pilot on board, but because there is no room or capacity to carry such an item on the aircraft. The equivalent level of safety will be maintained by keeping the flight manual at the ground control point where the pilot flying the UAS will have immediate access to it.

14 C.F.R. § 91.109(a) & 91.319(a)(1): Flight Instruction

These regulations provide that no person may operate a civil aircraft (except a manned free balloon) that is being used for flight instruction unless that aircraft has fully functioning dual controls. The UX5 is a remotely piloted aircraft and by design, does not have fully functional dual controls. Flight control is accomplished through the use of a control box that communicates with the aircraft via radio communications. The flight plan is pre-programmed into the auto pilot before flight and only in unusual circumstances will the pilot input control functions to alter the pre-programmed flight. If instruction is accomplished through a training program, as set forth in Exhibit 2, an equivalent level of safety will be assured. The FAA has approved exemptions for flight training without fully functional dual controls for a number of aircraft and for flight instruction in experimental aircraft. See Exemption Nos. 5778K & 9862A. The equivalent level of safety will be achieved by the manufacturer providing the training as outlined, and for the use of experienced and qualified pilots familiar with the Trimble UX5 and DJI S1000.

14 CFR § 91.119: Minimum Safe Altitudes

Section 91.119 establishes safe altitudes for operation of civil aircraft. Specifically, 91.119(c) limits aircraft flying over areas other than congested areas to an altitude of 400 feet above the surface, except over open water or sparsely populated areas. In those cases, the aircraft may not be operated closer than 400 feet to any person, vessel, vehicle, or structure. As set forth herein, the UX5 will never operate at higher than 400 feet AGL. It will, however, be operated to avoid congested or populated areas that are depicted in yellow on VFR sectional charts. Because precision aerial survey and closed set cinematography must be accomplished at relatively low altitudes and at altitudes less than 400 feet AGL, an exemption from Section 91.119(c) is needed. The equivalent level of safety will be achieved given the size, weight, speed, and material with which the UX5 is built. Also, no flight will be taken without the permission of the land owner or those who control the land. Because of the advance notice to the landowner, all affected individuals will be aware of the survey flights. Compared to aerial survey operations conducted with aircraft or rotorcraft weighing far more than 5.5 lbs. and carrying flammable fuel, any risk associated with these operations will be far less than those currently allowed with conventional aircraft operating at or below 400 feet AGL. Indeed, the low-altitude operations of the UAS will maintain separation between these small-UAS operations and the operations of conventional aircraft that must comply with Section 91.119.

14 C.F.R. § 91.151(a): Fuel Requirements for Flight in VFR Conditions

This regulation prohibits an individual from beginning “a flight in an airplane under VFR conditions unless (considering wind and forecast weather conditions) there is enough fuel to fly to the first point of intended landing and, assuming normal cruising speed – (1) During the day, to fly after that for at least 30 minutes; or (2) At night, to fly after that for at least 45 minutes.” Both the Trimble UX5 and DJI S1000 batteries provide approximately 50 minutes of powered flight. Without an exemption from § 14 CFR 91.151, the UAS’s flights would be limited to approximately 20 minutes in length. Given the limitations on its proposed operation and the location of those proposed operations, a

longer time frame for flight in daylight VFR conditions is reasonable. Operating the small UAS, without 30 minutes of reserve fuel does not engender the type of risks that Section 91.151(a) was meant to prevent given the size and speed at which the UAS operates. The fact that it carries no pilot, passenger, or cargo also enhances its safety. Additionally, limiting Trimble UX5 and DJI S1000 flights to 20 minutes would greatly reduce their utility. In the unlikely event that the Trimble UX5 and SJI S1000 should run out of fuel, it would simply land. Given its weight and construction material, the risks are less than contemplated by the current regulation.

Terra Imaging believes that an equivalent level of safety can be achieved by maintaining 10 minutes of reserve fuel, which, allowing 40 minutes of flight time, would be more than adequate to return the UAS to its planned landing zone from anywhere in its operating area.

14 C.F.R. § 91.203 (a) & (b): Carrying Civil Aircraft Certification and Registration
This regulation provides as follows:

(a) . . . no person may operate a civil aircraft unless it has . . . an appropriate and current airworthiness certificate.

(b) No person may operate a civil aircraft unless the airworthiness certificate required by paragraph (a) of this section or a special flight authorization issued under §91.715 is displayed at the cabin or cockpit entrance so that it is legible to passengers or crew.

The Trimble UX5 and DJI S1000 fully loaded weighs no more than 50 lbs. As such, there is no ability or place to carry certification and registration documents or to display them on the UAS. In addition, there is no pilot on board the aircraft. An equivalent level of safety will be achieved by keeping these documents at the ground control point where the pilot flying the UAS will have immediate access to them. The FAA has issued numerous exemptions to this regulation. A representative sample of other exceptions includes Exemption Nos. 9565, 9665, 9789, 9789A, 9797, 9797A, 9816A, and 10700.

14 C.F.R. § 91.405(a); 407(a)(1); 409(a)(2); 417(a): Maintenance Inspections

Section 91.405(a) requires that an aircraft operator or owner “shall have that aircraft inspected as prescribed in subpart E of this part and shall between required inspections, except as provided in paragraph (c) of this section, have discrepancies repaired as prescribed in part 43 of this chapter” Section 91.407 similarly makes reference to requirements in Part 43; Section 91.409(a)(2) requires an annual inspection for the issuance of an air worthiness certificate. Section 91.417(a) requires the owner or operator to keep records showing certain maintenance work that has been accomplished by certificated mechanics, under Part 43, or licensed pilots and records of approval of the aircraft for return to service.

Maintenance of the Trimble UX5 and DJI S1000 will be accomplished by Terra Imaging pursuant to the manuals provided by Trimble. An equivalent level of safety will be achieved because the UAS is small in size, will carry no external payload, will operate only in restricted predetermined areas and is not a complex mechanical devise. Terra Imaging will ensure that the UAS is in working order prior to initiating flight, perform

required maintenance, and keep a log of any maintenance that is performed. Moreover, the operator is the person most familiar with the aircraft and is best suited to maintain the aircraft in an airworthy condition and to ensure an equivalent level of safety.

The Trimble UX5 and DJI S1000's Maintenance Manual provides for replacement of the airframe every 50 hours of flight. This will ensure an equivalent level of safety to the maintenance requirements in Part 91. In addition, between such air frame replacements, should a mechanical issue arise, the aircraft will either return to its launch site or immediately land.

Sincerely,

A handwritten signature in black ink, appearing to read 'Karl Engstrom', with a long horizontal flourish extending to the right.

Karl Engstrom – President and CEO
Terra Imaging LLC
Telluride, CO – USA
www.terraimaging.com

Summary of Terra Imaging Exception Request

Terra Imaging LLC hereby provides pursuant to Part 11 a summary of its exemption application to allow commercial operation of the UX5 and DJI S1000 unmanned aircraft in precision aerial survey and closed set cinematography. An exemption is requested from the following regulations:

14 C.F.R. Part 21;

14 C.F.R. 45.23(b);

14 C.F.R. 61.113(a) & (b);

14 C.F.R. 61.133(a);

14 C.F.R. 91.7(b);

14 C.F.R. 91.9(b)(2);

14 C.F.R. 91.109(a);

14 C.F.R. 91.119;

14 C.F.R. 91.151(a);

14 C.F.R. 91.203(a) & (b);

14 C.F.R. 91.405(a);

14 C.F.R. 91.407(a)(1);

14 C.F.R. 91.409(a)(2);

14 C.F.R. 91.417(a).

February 19th 2015

U.S. Department of Transportation
Docket Management System
1200 New Jersey Ave., SE
Washington, DC 20590

Re: Exemption Request Under Section 333 of the FAA Reform Act and
Part 11 of the Federal Aviation Regulations

Dear Sir or Madam:

Pursuant to Section 333 of the FAA Modernization and Reform Act of 2012 (the "Reform Act") and 14 C.F.R. Part 11, Terra Imaging LLC ("Terra Imaging"), operators of Unmanned Aircraft System ("UAS"), seeks an exemption from the Federal Aviation Regulations ("FARs") listed below.

*In addition to the Exception to Rulemaking document provided, please accept this amendment document, specifically addressing the need for a certified pilot to be included in the current document folder: FAA-2015-0386-0002

14 C.F.R. § 61.113 (a) and (b): Private Pilot Privileges and Limitations: Pilot in Command. Pursuant to 14 CFR 61.113 (a) & (b), no person who holds a private pilot certificate may act as a pilot in command of an aircraft that is carrying passengers or property for compensation or hire.

Answer: Given the current state of approval for the current 333 exceptions, Terra Imaging acknowledges that the Pilot in Command (PIC) must hold either an airline transport, commercial, private, recreational, or sport pilot certificate. The PIC must also hold a current FAA airman medical certificate or a valid U.S. driver's license issued by a state, the District of Columbia, Puerto Rico, a territory, a possession, or the Federal government. The PIC must also meet the flight review requirements specified in 14 CFR § 61.56 in an aircraft in which the PIC is rated on his or her pilot certificate.

Please feel free to contact me directly with any questions pertaining to this exception.

Sincerely,

Karl Engstrom - CEO
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